

Conference: SPIE 2011
Location: San Diego, CA
Dates: 8/21 – 8/25/11

Title: “Vacuum Nuller Testbed Performance, Characterization and Null Control”

Presenter: R. G. Lyon

Abstract:

The Visible Nulling Coronagraph (VNC) can detect and characterize exoplanets with filled, segmented and sparse aperture telescopes, thereby spanning the choice of future internal coronagraph exoplanet missions. NASA/Goddard Space Flight Center (GSFC) has developed a Vacuum Nuller Testbed (VNT) to advance this approach, and assess and advance technologies needed to realize a VNC as a flight instrument.

The VNT is an ultra-stable testbed operating at 15 Hz in vacuum. It consists of a Mach-Zehnder nulling interferometer; modified with a “W” configuration to accommodate a hex-packed MEMS based deformable mirror (DM), coherent fiber bundle and achromatic phase shifters. The 2-output channels are imaged with a vacuum photon counting camera and conventional camera. Error-sensing and feedback to DM and delay line with control algorithms are implemented in a real-time architecture.

The inherent advantage of the VNC is that it is its own interferometer and directly controls its errors by exploiting images from bright and dark channels simultaneously. Conservation of energy requires the sum total of the photon counts be conserved independent of the VNC state. Thus sensing and control bandwidth is limited by the target stars throughput, with the net effect that the higher bandwidth offloads stressing stability tolerances within the telescope.

We report our recent progress with the VNT towards achieving an incremental sequence of contrast milestones of 10^8 , 10^9 and 10^{10} respectively at inner working angles approaching $2\lambda/D$. Discussed will be the optics, lab results, technologies, and null control. Shown will be evidence that the milestones have been achieved.